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# LESIONS OF THE CAUDA EQUINA.

*Hæmorrhage into the Cauda Equina.*

*Fracture of the Spine with Hæmorrhage into the Cauda Equina.*

*Fracture of the Spine with Hæmorrhage into the Lumbo-sacral Spinal  
Cord and Cauda Equina.*

*A Clinical Lecture, delivered at the Philadelphia Hospital,  
November 23, 1889,*

BY

CHARLES K. MILLS, M.D.,

NEUROLOGIST TO THE PHILADELPHIA HOSPITAL ; PROFESSOR OF DISEASES OF THE  
MIND AND NERVOUS SYSTEM IN THE PHILADELPHIA POLYCLINIC.



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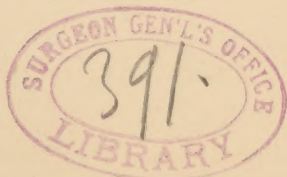
**LESIONS OF THE CAUDA EQUINA.**

*Hæmorrhage into the Cauda Equina. Fracture of the Spine with Hæmorrhage into the Cauda Equina. Fracture of the Spine with Hæmorrhage into the Lumbo-sacral Spinal Cord and Cauda Equina.*

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TO-DAY your attention will be directed to three cases of injury of the lower part of the vertebral column, the lesions in all affecting the leash of nerves called the cauda equina. A glance at a specimen of the back bone with the spinal cord and its nerves in position, shows the considerable length of the portion of the canal in which the cauda equina hangs—six inches at least. This is one of the best protected spaces in the human body. The spines, arches, and bodies of the vertebræ are of greater bulk and strength than elsewhere, and dislocations and fractures of the vertebræ can only result from the application of a great crushing, twisting, or rending force. Injuries to this part of the human framework, however, while not common are not extremely rare, because it is often exposed to certain accidents during the performance of heavy labor, and also because in falls from heights, or in severe blows or crushes, hæmorrhage into this region is particularly likely to occur. Occasionally also lesions of the cauda equinal space are secondary to disease or injury of the spinal column, membranes, or cord at a higher level; as the result, for example, of a fracture or dislocation, or, at least, in connection with either of these injuries, a hæmorrhage may take place in the dorsal cord, and the blood find its way down the smooth intra-spinal spaces to the lowest and widest portion of the canal; or,





an inflammatory process may extend along the membranes to the cauda equina.

Comparatively little attention has been paid to traumatic or other lesions of the cauda equina until the last two or three years. Cases have been reported from time to time, a few with post-mortem records. Not a few of the cases without autopsies which are to be found in surgical literature, evidently examples of affections of the cauda equina, are reported under other names, as, for instance, concussion and myelitis. The most systematic and valuable papers on this subject are those of Thorburn,<sup>1</sup> of Manchester, England. In this country Osler<sup>2</sup> has reported a few cases of disease or injury to the conus medullaris or cauda, and I have also put on record two or three traumatic cases.<sup>3</sup> In the papers of Thorburn the literature of the subject has been collected, but it is meagre.

Diseases and injuries of the cauda equina have both a scientific and a directly practical interest. Their study throws light upon some questions in sensory, motor, trophic and visceral physiology; as, for example, the exact cutaneous and muscular distributions of certain nerves, and the position of anal, vesical, sexual, or other centres in the spinal cord. They are, in fact, often excellent experiments for determining the functions of spinal segments and nerves. Practically they are of great importance for diagnosis, prognosis, and treatment. Some of the problems of diagnosis will be treated of after the presentation of the cases. As regards prognosis, while some of the cases are of the greatest possible seriousness, resulting fatally or causing extensive and permanent paralysis, others which at first have an entirely hopeless appearance make partial and occasionally almost complete recoveries. One question in the treatment of these cases is whether or not trephining should be performed, a problem by no means easy to decide. Thorburn advocates operation in most cases. On the one hand we have a region of the spinal column chiefly containing nerves, and not the more vital and delicate cord, and, therefore, operation offers considerable hope and is less dangerous. On the other hand, however, cases apparently desperate and hope-

<sup>1</sup> Brain, January, 1888, and Medical Chronicle, April, 1888.

<sup>2</sup> THE MEDICAL NEWS, December 15, 1888, and Journal of Nervous and Mental Diseases, August, 1889.

<sup>3</sup> Therapeutic Gazette, May and June, 1889.

less at first, under rest, absorbents, electricity and time, make such approximate recoveries as to throw doubt upon the value of active surgical interference. The cases which will be presented this morning illustrate both sides of this problem of prognosis and treatment. Two of them have made partial recoveries from conditions of almost complete sensory and motor paralysis, although they are by no means entirely relieved from suffering and disability. The third case is one in which injury, probably a fracture, accompanied or followed by hæmorrhage, has left the patient in a hopeless condition of paralysis and suffering, and is probably one in which if operation had been early performed, much of this misery and helplessness might have been saved.

The first patient I bring before you, as you see, walks about with some spryness, but has a peculiar, limping, thumping gait, the motor defect which causes it being seemingly more marked in one limb than the other. The following are the notes of his history:

CASE I. *Hæmorrhage into the cauda equina from traumatism: involvement of certain sacral nerves; marked anæsthesia in the distribution of the small sciatic, pudic, inferior hæmorrhoidal, and inferior pudendal; imperfect anæsthesia in other areas; paralysis in some of the muscles from the sacral segment: vesical and anal symptoms; great improvement.*—M. H., aged forty-four, white, born in Ireland, a laborer, in August, 1887, while carrying a hod, fell from a scaffold twenty-five feet from the ground, and landed on his feet. He broke no bones, but could not walk. He was taken in an ambulance to the German Hospital, where he remained four months. For the first fifteen hours he is quite sure he had normal sensation in his legs, which he could also move up and down without difficulty, but during this time he had great pain in his back, especially when he attempted to move. He also had pain in the pelvis and in the upper gluteal regions. After fifteen hours he began to have pains and cramps in the left foot and leg, which were drawn. The leg also became swollen and blue. The right leg then developed the same symptoms, and both were drawn up and swollen, and blue to the hips. This condition made him practically helpless; his legs had to be lifted about when a change of position was desired.

His limbs began to improve, and they are now very much better. After the first fifteen hours he had incontinence of urine, and has been troubled with this ever since

to a greater or less degree; now but slightly. For the first six months his bowels were constipated or torpid, and since that time he has suffered at times from incontinence of fæces. A tingling sensation is felt in the legs, most marked in the calves, posterior part of the thigh and buttocks, and in the left leg. In this leg he also has at times the sensation of a small stream of water flowing down the inner side of the thigh and leg. The knee-jerk is exaggerated in both legs. He says that both of his legs increase in size at times, and that the tingling sensations also are sometimes worse. He suffers sometimes from vertigo, particularly in the afternoon, but otherwise, he says, he is particularly well. His legs are not atrophied. On the posterior aspect of each thigh is a limited area of complete anaesthesia, represented in Fig. 1. The defective sensation is over the posterior central portion of the upper thigh, and the gluteal and sacral regions. It also extends to the perineum, scrotum, and penis, as shown in Fig. 2.

Let us now examine with some closeness the present condition of our patient as to motion, sensation, the state of his bladder, rectum, etc. He has fairly good use of his limbs, and is now working about the hospital. He uses his sartorius, quadriceps, abdominal, and pelvic muscles well. He also has control of his hamstring or flexor muscles. Proceeding below the knee, the first weakness is found in the gastrocnemius, soleus, and posterior tibial. The anterior tibial movement is also impaired. He has a limited defect in the movement of certain muscles of the left foot, the right showing a similar but better condition.

This examination of the patient for motor paralysis shows that the loss which is now present is chiefly dependent upon compression or destruction of the nerves which go from the sacral spinal segments, with very likely also involvement of the nerve-fibres proceeding from the fourth lumbar segment. This conclusion will be confirmed by an examination of the following table of the segmental representation of muscles from the fourth lumbar segment downward:<sup>1</sup>

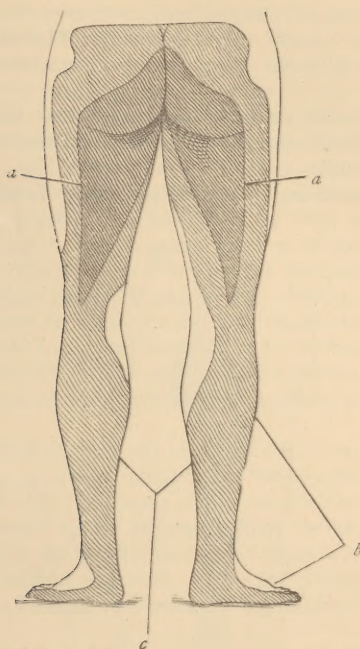
Fourth lumbar segment: Abductors of thigh, adductors of thigh, flexors of knee, tibialis anticus, peroneus longus.

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<sup>1</sup> From paper on Spinal Localization, *Therapeutic Gazette*, May and June, 1889.

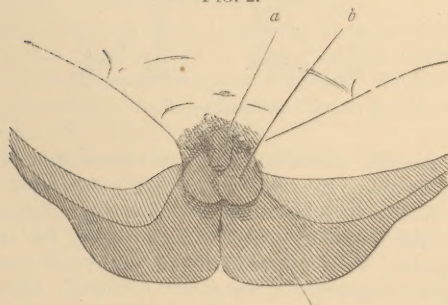


FIG. 1.



- a.* Small sciatic.  
*b.* Ext. saphenous.  
*c.* Int. long saphenous, branch of ant. crural.

FIG. 2.



- a.* Dorsal nerve of penis, branch of inf. pudic. Superficial cutan. perineal.  
*b.* Superficial cutaneous perineal, branch of inf. pudic. Inf. pudendal, branch of small sciatic.

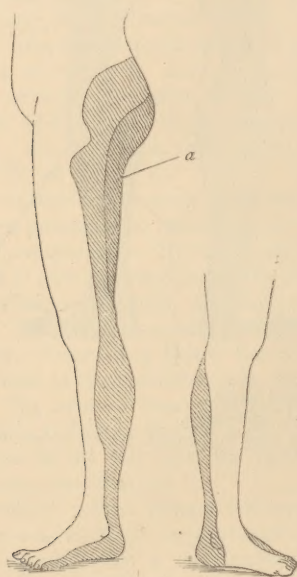
Fifth lumbar segment: Outward rotators, flexors of knee, flexors of ankle, peronei, extensors of toes.

First and second sacral segments: Flexors of ankle, extensors of ankle, long flexor of toes, intrinsic foot-muscles.

Third, fourth, and fifth sacral segments: Gluteus maximus, perineal, muscles of the bladder, rectum, and external genitals.

Fifth sacral and coccygeal segments: Coccygeus muscles.

FIG. 3.



a. Small sciatic.

As already indicated, the movements most affected are those about the ankle, particularly extension of the foot, chiefly performed by the gastrocnemius and its associated muscles. Other movements of the toes are weakened. These movements are governed mainly by the sacral segments of the cord. Evidently the nerves which escape from the spinal canal lowest down are the most affected. Thorburn regards it as established that in a pressure lesion of the entire cauda equina, those nerve-roots which emerge lower down are more seriously



injured than those above them. In a case of hæmorrhage into the cauda-equinal space, this is what might be expected from the settling of the blood.

Dr. Rosenau, one of the internes of the hospital, who studied these cases carefully with me during his term of service, has made several diagrams of this case which show the areas of loss and defect of sensation. They show back and side views of the patient, and also views of the external genitals, perineum, and adjacent region (Figs. 1, 2, and 3). They show by dark and lighter shading that in certain areas the loss of sensation was absolute, while in others it was partial, and both the absolute and partial areas of anæsthesia illustrate the distribution of certain sensory nerves which are close together in the cauda equina, almost as clearly as they could by an experiment in which some of these nerves were completely severed, while others were partially cut or compressed.

The following, from my table<sup>1</sup> of the "Localization of the Functions of the Spinal Cord," shows the cutaneous areas, and also the names of the nerves corresponding to the different spinal segments, from the third lumbar downward to the termination of the spinal cord:

Third lumbar segment: Front of thigh. (Middle cutaneous, internal cutaneous, long saphenous, obturator.)

Fourth lumbar segment: Inner side of thigh, leg, and foot. (Internal cutaneous, long saphenous, obturator.)

Fifth lumbar segment: Back and outer side of leg, sole, dorsum of foot. (External popliteal, external saphenous, musculo-cutaneous, plantar.)

First and second sacral segments: Back and outer side of leg, sole, dorsum of foot. (Same as fifth lumbar.)

Third, fourth, and fifth sacral segments: Back of thigh, anus, perineum, external genitals. (Small pudic, inferior hæmorrhoidal, inferior pudendal.)

Fifth sacral and coccygeal segments: Skin about the anus and coccyx. (Coccygeal.)

A study of this table in connection with the examination of this patient, shows the nerves affected to be some of those given off from the fifth lumbar to the coccygeal segment. The area of complete anæsthesia and analgesia is that supplied by the small sciatic, pudic, inferior hæmorrhoidal, and inferior pudendal nerves, which arise

<sup>1</sup> Op. cit.

from the lower part of the sacral plexus and from the lowest segments of the spinal cord (Figs. 1 and 2). The area of incomplete anæsthesia is mostly in the distribution of the external and long saphenous nerves. Generally speaking, the sensory nerves which escape belong to higher segments of the cord than those which are involved, the exception to this being the partial involvement of the long saphenous which comes from the third and fourth lumbar segments.

It is now pretty generally conceded that the anovesical centre in man is situated in the lowest segments of the spinal cord, and this case, and, indeed, the others which I will presently examine before you, confirm this view. The swelling and the blueness of the limbs were vasomotor affections connected with the nerve injuries. The pains which he suffered after the accident were, doubtless, from direct irritation of the nerve trunks by the lesion. This patient shows no external deformity as the result of his injury. If a fracture occurred at all, it must have been without displacement, and, on the whole, the probabilities are that the case is one of hæmorrhage.

Briefly reviewed, we have the history of an injury resulting from a fall from a height with a sudden loss of power in the legs. He had at first little loss of sensation, although after fifteen hours it became much greater than is now present. He had also immediately after the injury great pain in the back, shooting thence down the limbs and toward the pelvis and the perineum. Paralysis, anæsthesia, and shooting pain were then his symptoms, moderate in degree at first, and in fifteen or twenty-four hours increasing in severity, showing that probably the hæmorrhage which occurred at the time of the injury had been followed by an additional flow of blood in a few hours. He also had symptoms showing an involvement of his bladder and rectum—namely, incontinence of urine and fæces. We find no indication of a lesion high up in the cord. As we can pick out the exact sensory and motor nerves affected, we learn the exact height of the lesion in the spinal canal, and the nerves affected in their intra-spinal course.

As far as treatment is concerned, on the whole, it was wise to let him alone at first. He had no sign of external injuries. It was probably a purely hæmorrhagic case, and in trephining we would have done so only for a hæmorrhage. It might have been well to have

done this, aspirating the blood, and so have prevented degeneration of the nerves from compression ; but now it would not be worth while. Possibly if he had been trephined, he might have been in a better condition than he now presents, but still a conservative surgeon would probably not have operated in such a case.

CASE II.—*Fractures of the spine and posterior vertebral arch, with probable hæmorrhage into the cauda equina. Sensory and motor symptoms similar to Case I., but less marked.*—T. C., twenty-six years old, while working on a railroad was, with two other men, crushed by a truck loaded with coal being thrown backward upon him. At once he had tingling and numb sensations in his legs, and could not sit nor stand. For about

FIG. 4.



a. Small sciatic.

fifteen or twenty minutes he could move his legs, but had loss of power and sensation in them. About four hours after the accident he began to have pain shooting from the sacrum down both legs. He was four months in bed, unable to stand or walk, but gradually recovered



power in the legs, and at the end of that time could stand by holding on to a chair; since then he has been gradually getting better. If constipated, he is compelled to remove the fæcal mass mechanically, but if his bowels are loose he has loss of control over them. He uses the catheter, and if he is careful there is no dribbling. When the bladder is full he can pass some urine voluntarily. The dribbling is from overflow, the paralysis appearing to be rather of the bladder walls than of the sphincter. Sexual power and inclination are diminished but not lost.

This case presents features almost identical with those shown by Case I., only the amount of damage to the cauda equina is less, as shown by the narrower area of complete anæsthesia (Fig. 4). No area of imperfect sensation surrounds that of total anæsthesia.

He has little loss of power in his legs, though, as he says, his left leg thumps a little in walking. At first completely paralyzed, he has now only a slight loss of power in his left foot. The little trouble remaining is mainly in his ankle extensors, which are represented low in the sacral segments. We have here then the same sort of lesion as in the other case. He has, however, a very visible deformity on his back, the result of the injury in about the position of the first lumbar spine. He probably suffered a fracture, not of the bodies of the vertebræ, but of one or two posterior arches and spines, which were driven in and somewhat over, thus causing deformity. A hæmorrhage may also have occurred at the same time, and have found its way down into the cauda equina, although this is uncertain. It is possible that this fracture is still allowing bone to press upon the conus or nerves, thus giving rise to the symptoms. Trephining here offers some hope of improvement for his ano-vesical, sexual, and sensory symptoms.

The third case is much more serious in its nature than either of the other two, and trephining should have been performed at once.

CASE III. *Probable fracture of the spine with hæmorrhage into the lumbo-sacral spinal cord and cauda equina; marked anæsthesia in the distribution of the sensory nerves from the fourth lumbar to the coccygeal segments; almost complete paraplegia in the muscles supplied from the third lumbar segment to the extremity of the conus; advanced vaso-motor, trophic, and electric changes.*—K. M., aged sixty, born in Ireland, a domes-

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tic, two years ago fell from a shed and injured her spine, immediately losing power in the lower limbs, and having sharp pains radiating round the abdomen. We will not go into a detailed examination of this case, but will give briefly the results of examination. The patient presents complete motor paraplegia of the lower extremities with foot-drop. Knee-jerk is abolished, and sensation much impaired. The bladder and rectum are paralyzed. The skin is glossy. There is sensitiveness to pressure over the upper lumbar spine. Examination shows a large curvature of the back with projection beginning about the sixth dorsal vertebra and reaching to the sacrum. The left side of the back from the sixth dorsal down has a bulging appearance. She complains of tenderness all along the spine below the second dorsal vertebra. It is a question how far the curvature is angular from vertebral disease, and how far muscular due to abnormal positions. She has considerable power to twist and move the trunk in spite of the deformity. She does not present any indication of caries. The limbs are wasted and mottled, and are much colder than they should be. The nails are brittle and show bad nutrition. Faradic and galvanic contractility are abolished in most of the muscles of the lower limbs. Here are diagrams showing her condition as to sensation. (Figs. 5 and 6.)

As you see, her legs can only be moved a little above the knee, and not at all below. She has some power in the pelvic muscles. As to sensation, the loss is almost absolute below the knee anteriorly; behind one can pass all the way up the thigh without finding any sensation, provided in the popliteal region we keep within a narrow isthmus. The genitals and the same regions of the buttocks and thighs are anæsthetic, as well as the coccyx and anus, as in the other cases. We have here, then, an involvement of all the motor and sensory sacral nerves, and to some extent those of the lumbar segments, with accompanying vaso-motor, trophic, and electrical changes, the result of a fracture of the spine above the sacral segments over the conus, or of a crushing of the whole lumbo-sacral portion of the spinal cord.

These cases, as already stated, present points of great interest for diagnosis, both local and general. Thorburn gives injury or disease of the lower part of the cord, extra-spinal nerve disease and injury, and locomotor ataxia as the diseases and conditions from which injury or disease of the cauda equina is to be differentiated.

If we bear in mind the definite physiological symptoms—the circumscribed cutaneous areas of loss of sensation, the exact muscles and muscular groups paretic or paralyzed, and the peculiar involvement of the bladder, rectum, and genitals, the matter of diagnosis will be greatly simplified. Myelitis must be distinguished by its history, and by the peculiar distribution of the loss of sensation and motion characteristic of that disease. This is, however, a difficult diagnosis, if the myelitis attacks the lowest portion of the cord.

FIG. 6.

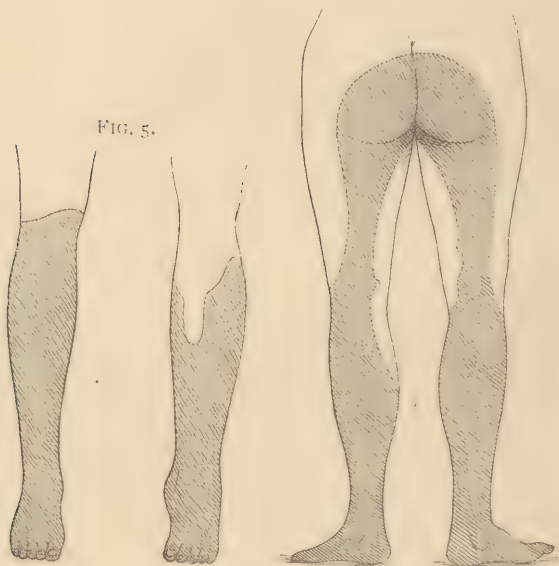


FIG. 5.

Thorburn<sup>1</sup> speaks as follows of the diagnosis from injury or disease of the lower part of the spinal cord: "Here we must be guided by the exact site of the local symptoms, if any be present, remembering that the cord does not extend below the lower border of the first lumbar vertebra. Also, if the cord be there injured, there will probably be some anæsthesia or hyperæsthesia of the last dorsal or first and second lumbar nerves; and

<sup>1</sup> Brain, January, 1888, p. 403.



again we may expect more rapid trophic lesions than in injuries of the cauda. If the symptoms be asymmetrical, we have probably to do with an affection of the cauda rather than of the cord. Whether in a partial crush above the level of the last dorsal vertebra, the damage down to the anterior crural nerves bears the same relation to that done to the sciatics, as in a crush lower down, I have at present no evidence to determine."

Disease or injury of the nerves or nerve plexuses outside of the spinal canal—lumbar or sacral—might sometimes be confounded with affections of the cauda equina. Thorburn says that the only disease of this kind liable to be mistaken for an affection of the cauda equina is some variety of multiple neuritis, and that we may usually decide the point by finding some affection of the upper limbs, by the marked preference of that disease for the extensor surfaces, and by the slighter sensory symptoms. Some of the affections to which I have called attention in a paper on "Lesions of the Sacral and Lumbar Plexuses,"<sup>1</sup> might occasionally be confused with disease of the cauda equina. These affections are neuritis, neuromata, non-neural growths implicating nerves, caries, abscesses, gunshot and other injuries, and rectal, ovarian, or even uterine disease. Usually these affections are unilateral, and this fact will serve to separate them from lesions of the cauda equina. Bilateral lesions of the sacral plexuses, such as neuritis, paralysis from labor, and tumors in both pelvic cavities sometimes occur. In some of these cases close examination by the rectum will be of great assistance. Unilateral affections of the cauda equina, while conceivable, are exceedingly rare.

It would hardly be thought probable that locomotor ataxia, of which disease our knowledge is now so full, could be confounded with the affections under consideration, and yet within a few weeks I have seen in consultation a patient in whom this mistake was made. This patient was a man between sixty and seventy years of age, a free liver, who sixteen months before coming under my observation had a slight cerebral apoplectic attack, probably a small hæmorrhage. From this he recovered rapidly. One year later he was taken suddenly with severe pain in the lower part of his back, which lasted for several days, and left him paralyzed,

both as to sensation and motion, in both his legs. He also had sharp, shooting pains coming and going in various parts of his legs. He was confined to his bed for nearly three months, all the time slowly improving. His bladder was affected from the first, the urine dribbling nearly all the time. His rectum was also paralyzed. When examined by me his symptoms were very similar to those presented by the patients we have studied this morning. His left leg was almost completely paralyzed below the knee, his muscles showing the reaction of degeneration. The right leg was paretic, all movements being preserved, but nearly all deficient. He had absolute loss of sensation in the distribution of the small sciatic, pudic, inferior hæmorrhoidal, and inferior pudendal nerves, with also loss of sensation below the knees, similar to Case III., although not as complete. He had a sprawling, halting, clumsy gait, somewhat like that of an ataxic, and he complained of feeling as if he was walking or sitting on gum. Several physicians had regarded the case as one of locomotor ataxia. It certainly bore all the marks of a hæmorrhage or tumor of the cauda equina, probably the former, owing to the rapidity with which the symptoms developed. The diagnosis in this case and in others is to be made by a careful consideration of both history and symptoms. The simulation of posterior spinal sclerosis is coarse and not likely to deceive on careful examination. The history of sudden onset, whether following injury or not, would be in favor of an affection of the cauda equina. While locomotor ataxia is sometimes the result of injury, the disease does not develop abruptly. The pains of locomotor ataxia are more irregularly distributed and have usually gradually increased, both in severity and extent, over a long period. In locomotor ataxia the loss of sensation or the retardation of sensory conduction is usually bilateral and not generally so complete. In lesions of the cauda equina we have, as shown by these cases, clearly defined areas of loss of sensation according to the nerve or nerves involved. Pupillary and other ocular symptoms, gastric crises, and generally symptoms above the waist, are entirely absent. Reaction of degeneration is present in disease of the cauda equina, and close examination shows true paralysis of cer-

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<sup>1</sup> THE MEDICAL NEWS, June 15, 1889.

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tain muscles, while the apparent or real incoördination, when present, is the result of defective sensation in the feet. When diseases and injuries of the cauda equina have been brought sufficiently before the profession this mistake will not often be made.







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